
कृषि प्रयोजनों हेतु उपकेन्द्री पंप हेतु एक फेजी,
ए.सी. विद्युत की छोटी मोटर — विशिष्टि
(पहला पुनरीक्षण)

**Single Phase Small a.c. Electric
Motors for Centrifugal Pumps
for Agricultural
Applications — Specification**
(*First Revision*)

ICS 29.160.30

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FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Rotating Machinery Sectional Committee had been approved by the Electrotechnical Division Council.

There are a number of centrifugal pump installations for agricultural application using single phase induction motors as the prime mover. Though there is a separate Indian Standard specifying requirements for 3 phase induction motors for centrifugal pumps, a similar standard was not available in the case of single phase motors for centrifugal pumps. This Indian Standard is, therefore, prepared with a view to bringing about uniformity in various requirements such as torque, current, etc, and also to ensure interchangeability by specifying standard frame sizes. IS 7538 : 1996 'Three-phase squirrel cage induction motors for centrifugal pumps for agricultural application (*first revision*)' covers requirements for three-phase squirrel cage induction motors suitable for wider voltage variations.

Guidance for testing single-phase ac electric motors is given in IS 7572 'Guide for testing single-phase a.c. and universal motors'.

To ensure satisfactory installation and maintenance of induction motors, it is urged that the recommendations contained in IS 900 : 2019 'Code of practice for installation and maintenance of induction motors (*third revision*)' should be carefully followed.

This standard was originally published in 1998. This edition includes the following significant changes with respect to the previous edition:

- a) updating of referred Indian Standards.
- b) Addition of reduced voltage running up test in routine test.
- c) Addition of a new rating (2200 W) for capacitor start capacitor run and Capacitor Start and Run motors.

The composition of the Committee, responsible for the formulation of this standard is given at Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SINGLE PHASE SMALL a.c. ELECTRIC MOTORS FOR CENTRIFUGAL PUMPS FOR AGRICULTURAL APPLICATIONS — SPECIFICATION

(*First Revision*)

1 SCOPE

This standard covers 2 and 4-pole single-phase a.c. electric motors for centrifugal pumps for agricultural applications for voltage up to and including 250 V and having output up to and including 2200 W.

1.1 The following types of motors are covered:

- a) Capacitor start capacitor run;
- b) Capacitor start and run; and
- c) Capacitor start induction run.

1.2 This standard does not cover requirements of motors for submersible pumps.

2 REFERENCES

The standards listed in Annex A contain provisions which through reference in this text, constitute provision of this standard. At the time of publication, the editions indicated were valid. All standards are subjected to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying most recent editions of the standards.

3 TERMINOLOGY

For the purpose of this standard, definitions given in IS 1885 (Part 35) shall apply.

4 SITE CONDITIONS

4.1 Altitude and Temperature

Motors shall be designed for the following site conditions unless otherwise agreed between the manufacturer and the purchaser.

4.1.1 Altitude

Altitude not exceeding 1 000 m.

4.1.2 Temperature

The cooling medium temperature not exceeding 40 °C.

4.2 Voltage and Frequency Variation

Motors shall be capable of delivering the rated output with:

- a) the terminal voltage differing from the rated value by not more than + 6 percent and – 15 percent,
- b) the frequency differing from its rated value by not more than ± 3 percent, or
- c) any combination of (a) and (b).

In case of continuous operation at extreme voltage limits, the temperature-rise limits specified in Table 7 of IS 15999 (Part 1) shall not exceed by more than 10 °C. Motors, when operated under the extreme conditions of voltage and frequency variation may not necessarily have their performance in accordance with this standard.

4.3 It shall be assumed that the location and moisture or fumes shall not seriously interfere with the operation of the motor.

5 TYPES OF ENCLOSURES

The degree of protection to be provided by enclosures to the motor shall be IP 21, IP 22 or IP 23 (screen protected) or IP 44 or superior (totally enclosed) in accordance with IS/IEC 60034-5.

6 METHOD OF COOLING

The method of cooling shall be IC 01 or IC 41 in accordance with IS 6362.

7 MATERIALS

If desired by the purchaser, the materials and components used in the manufacture of motors shall conform to relevant Indian Standards, wherever they exist.

8 RATED CONDITIONS OF VOLTAGE, FREQUENCY, OUTPUT AND SPEED

8.1 Rated Voltage

The preferred rated voltage shall be 240 V in accordance with IS 12360.

8.1.1 Motors designed for operation at voltages other than 240 V shall be considered as complying with this standard provided they comply in all respects, except for values of maximum full load current, which shall

be changed in the inverse proportion to the voltage. The voltage for which the motor is designed shall be indicated on the nameplate.

8.2 Rated Frequency

Preferred rated frequency shall be 50 Hz.

8.3 Rated Outputs

The preferred output ratings shall be 180, 250, 370, 550, 750, 1 100, 1 500 and 2 200 watts.

8.4 Rated Speeds

Preferred rated speeds shall be those corresponding to capacitor start and run two poles and four poles.

9 DIMENSIONS

9.1 For Coupled Motors

The dimensions shall correspond to the standard frame sizes specified in IS 1231.

NOTE — the outputs assigned to the frame sizes covered in IS 1231 may not be applicable.

10 DUTY AND RATING

For the purpose of this, standard motors shall be continuously rated.

11 EARTHING

Earthing of the motor shall be done in accordance with the relevant provisions of IS 15999 (Part 1).

12 GENERAL CHARACTERISTICS

12.1 Breakaway (Starting) Torque

With rated voltage and frequency applied to terminals, the breakaway (starting) torque shall comply with the requirements given in Table 1.

Table 1 Minimum Breakaway Torque of Single-phase Motor
(Clauses 4.2 and 12.1)

SI No.	Type of Motor	Minimum Breakaway Torque as Percentage of Rated Torque
(1)	(2)	(3)
i)	Capacitor start capacitor run	150
ii)	Capacitor start and run	30
iii)	Capacitor start induction run	150

12.2 Overload

12.2.1 Sustained Overload

Motors rated in accordance with this standard are not capable of carrying sustained overloads.

12.2.2 Momentary Excess Torque

The motors shall be capable of withstanding on test the overloads in torque for 15 s given in Table 2 without stalling or abrupt change in speed (under gradual increase of torque), voltage and frequency being maintained at their rated values.

Table 2 Momentary Overload for Motors
(Clause 12.2.2)

SI No.	Type of Motor	Excess Torque as Percentage of Rated Torque
(1)	(2)	(3)
i)	Capacitor start capacitor run	60
ii)	Capacitor start and run	25
iii)	Capacitor start induction run	60

12.2.3 All the torque values shall be measured in accordance with IS 7572.

12.3 Temperature Rise

Temperature-rise of motors for all types of enclosures, when tested under the rated conditions and in accordance with the requirements of this standard, shall not exceed the limits given in IS 15999 (Part 1).

12.3.1 Measurement of Temperature-Rise

The measurement of temperature-rise shall be done in accordance with 8.5 of IS 7572.

12.4 Temperature-Rise Test at Reduced Voltage

Temperature-rise test at reduced voltage shall be carried out in accordance with IS 7572 at a test voltage of 85 percent of rated voltage. The temperature-rise shall not exceed the specified temperature limits in IS 15999 (Part 1) by more than 10 °C when the motor is continuously operating at 85 percent of rated voltage.

12.5 Insulation Resistance

Insulation resistance between all the windings combined and the motor frame shall be not less than 5 MΩ at 500 V d.c. The test shall be made on hot motor soon after the temperature-rise test.

12.6 High Voltage

The high voltage test shall be made in accordance with 6 of IS 7572 except that the test voltage should be 1 500 V (rms).

13 PERFORMANCE VALUES

13.1 The values of minimum full load speed, maximum full load current, nominal efficiency for 4-pole and 2-pole a.c. motors at rated conditions of 240 V, 50 Hz shall be in accordance with Tables 3 to 6.

NOTES

1 For motors having rated voltage other than 240 V, values given in Tables 3 to 6 shall be applicable except for value of maximum full load current which shall be changed in the inverse proportion of the voltage.

2 In case the manufacturer declares superior values of performance characteristics than those specified in Tables 1 and 3 to 6, the declared values shall be subject to verification. The test values of the performance characteristics shall confirm to those declared by the manufacturer within the tolerances specified in Table 7 and shall, in no case, be inferior to the values specified in Tables 1 and 3 to 6.

Table 3 Values of Performance Characteristics of Capacitor Start Capacitor Run and Capacitor Start and Run 4 Pole Motors

(Clause 13.1)

Sl No.	Rated Output W	Minimum Full Load Speed rev/min	Maximum Full Load Current A	Nominal Efficiency, Percentage
(1)	(2)	(3)	(4)	(5)
i)	180	1275	2.1	54.0
ii)	250	1300	2.8	56.0
iii)	370	1325	3.9	58.5
iv)	550	1350	5.3	62.0
v)	750	1350	6.6	66.0
vi)	1100	1375	9.1	69.0
vii)	1500	1375	12.2	70.0
viii)	2200	1425	14.5	73.0

Table 4 Values of Performance Characteristics of Capacitor Start Induction Run 4 Pole Motors

(Clause 13.1)

Sl No.	Rated Output W	Minimum Full Load Speed rev/min	Maximum Full Load Current A	Nominal Efficiency, Percentage
(1)	(2)	(3)	(4)	(5)
i)	180	1325	3.0	51.5
ii)	250	1325	3.9	55.0
iii)	370	1350	5.4	56.5
iv)	550	1350	7.6	58.5
v)	750	1375	9.5	63.0
vi)	1100	1375	12.9	64.5
vii)	1500	1375	16.8	67.0

Table 5 Values of Performance Characteristics of Capacitor Start Capacitor Run and Capacitor Start and Run 2 Pole Motors

(Clause 13.1)

Sl No.	Rated Output W	Minimum Full Load Speed rev/min	Maximum Full Load Current A	Nominal Efficiency, Percentage
(1)	(2)	(3)	(4)	(5)
i)	180	2600	2.1	54.0
ii)	250	2625	2.8	56.0
iii)	370	2650	3.7	59.0
iv)	550	2700	5.0	63.0
v)	750	2725	6.2	67.0
vi)	1100	2750	8.6	70.0
vii)	1500	2750	11.5	70.0
viii)	2200	2800	15.0	72.0

Table 6 Values of Performance Characteristics of Capacitor Start Induction Run 2 Pole Motors

(Clause 13.1)

Sl No.	Rated Output W	Minimum Full Load Speed rev/min	Maximum Full Load Current A	Nominal Efficiency, Percentage
(1)	(2)	(3)	(4)	(5)
i)	180	2650	2.9	51.5
ii)	250	2675	3.7	55.0
iii)	370	2700	5.1	57.5
iv)	550	2725	7.3	59.0
v)	750	2750	9.0	63.5
vi)	1100	2775	12.5	66.0
vii)	1500	2775	16.3	68.0

13.2 Unless otherwise specified, tolerances on performance shall be in accordance with Table 7. Where a tolerance is stated in only one direction, the tolerance in the other direction is considered unimportant.

Table 7 Schedule of Tolerances

(Clauses 13.1 and 13.2)

Sl No.	Performance Parameter	Tolerance
i)	Efficiency	– 15 percent of (100- η)
ii)	Power Factor ($\cos \phi$)	– 1/6 (1- $\cos \phi$), Min - 0.02; Max - 0.12
iii)	Slip of motor at rated full load	+ 20 percent of rated slip at full load
iv)	Breakaway (starting) torque	– 20 percent of the stated breakaway (starting) torque
v)	Breakaway starting current (locked rotor)	+ 20 percent of stated breakaway starting current

NOTE η = the efficiency expressed as percentage; and $\cos \phi$ = power factor.

14 TERMINAL MARKING

Terminal marking shall be in accordance with IS/IEC 60034-8.

15 RATING PLATE

15.1 A rating plate stating the following shall be supplied with each motor:

- a) Reference to this Indian Standard, that is, IS 14582;
- b) Type of motor (*see* Annex B);
- c) Name of the manufacturer;
- d) Manufacturer's number and frame reference;
- e) Type of duty rating;
- f) Rated voltage in volts;
- g) Frequency in Hz;
- h) Rated output in watts;
- j) Current in amperes at rated output;
- k) Speed in revolutions per minute at rated output;
- m) Class of insulation;
- n) Value of capacitor and voltage rating of capacitor; and
- p) Nominal efficiency.

15.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act, 2016* and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

16 TESTS

16.1 Tests specified shall normally be made at the manufacturer's premises.

NOTE — For the purpose of this standard, the tests to determine performance characteristics shall be made in accordance with methods specified in IS 7572.

16.1.1 The presence of user or his representative during the tests shall be agreed to between the manufacturer and the user.

16.2 Type Tests

The following shall constitute the type tests:

- a) Measurement of stator resistance;
- b) Test for no-load current, power input and speed at rated voltage and frequency;
- c) Test for breakaway (starting) torque at rated supply frequency (**12.1**);

NOTE — This test may be conducted at reduced voltage and the torque at the rated voltage may be obtained by calculating as proportional to the square of voltage.

- d) Locked rotor readings of voltage, current, power input and torque. This test may be made at reduced voltage;
 - e) Test for full-load performance at rated voltage and frequency (**13**);
 - f) Test for breakaway starting current at reduced voltage and rated frequency;
 - g) Temperature-rise test (**12.3**);
 - h) Temperature-rise test at reduced voltage (**12.4**);
- NOTE — For the tests at (g) and (h), the pump may be used for loading the motor,
- j) Momentary overload test (**12.2.2**);
 - k) Insulation resistance test (both before and after the high voltage test) (**12.5**); and
 - m) High voltage test (**12.6**).

16.3 Routine Tests

The following shall constitute the routine tests:

- a) Insulation resistance test (before high voltage test only) (*see* **12.5**);
 - b) High voltage test (*see* **12.6**);
 - c) Test for no-load current, power input and speed at rated voltage and frequency;
- NOTE — Also capacitor voltage where applicable.
- d) Locked rotor readings of voltage, current and power input at a suitable reduced voltage; and
 - e) Test for breakaway (starting) torque at rated supply frequency (*see* **12.1**).
- NOTE — This test may be conducted at reduced voltage and the torque at the rated voltage may be obtained by calculating as proportional to the square of voltage.
- f) Reduced voltage running up test shall be conducted at a voltage not exceeding 75 percent of voltage, to check ability of the motor to attain full speed.

16.4 Test Certificates

16.4.1 Unless otherwise specified when inviting tenders, the purchaser, if so desired by the manufacturer, shall accept manufacturer's certificate as evidence of the compliance of the motor with the requirements of this standard together with a type test (*see* **16.2**) certificate on a motor identical in essential details with the one purchased, together with routine test certificate on each individual motor for a batch of 20 or more similar motors is supplied on one order, type tests, as specified, shall be made on one of these motors, in addition to the other certificates if the purchaser so requires.

16.4.2 Certificates of routine tests (*see* **16.3**) shall show that the motor purchased has been run and has been found to be electrically and mechanically sound and in working order in all particulars.

16.4.4 Unless otherwise specified when inviting tenders, the user, if so desired by the manufacturer,

shall accept as evidence of compliance of the motors with requirements of this standard, certificates of tests made on a motor identical in essential details with the one purchased and of routine tests on each individual motor.

16.4.5 Certificate of routine tests shall show that the motor purchased has been run and has been found to

be electrically and mechanically sound and in working order in all particulars.

16.4.6 If user demands, then type tests as laid down in this standard shall be carried out on one motor in 250 provided the executive order quantity is 250 numbers or more, in one single lot.

ANNEX A

(Clause 2)

LIST OF REFERRED INDIAN STANDARDS

<i>IS No.</i>	<i>Title</i>	<i>IS No.</i>	<i>Title</i>
1231 : 2018	Dimensions of three-phase foot-mounted induction motors (<i>third revision</i>)	12360 : 1988	Voltage bands for electrical installations including preferred voltages and frequency
1271 : 2012	Thermal evaluation and classification of electrical insulation (<i>first revision</i>)	IS 15999 (Part 1) : 2016	Rotating Electrical Machines: Part 1 Rating and Performance (<i>first Revision</i>)
1885 (Part 35) : 1993	Electrotechnical vocabulary: Part 35 Rotating machinery	IS/IEC 60034-5 : 2000	Degrees of protection provided by enclosure for rotating electrical machinery (<i>first revision</i>)
6362 : 1995	Designation of methods of cooling of rotating electrical machines	IS/IEC 60034-8 : 2014	Rotating electrical machines: Part 8 Terminal markings and direction of rotation (<i>third revision</i>)
7572 : 1974	Guide for testing single-phase a.c. and universal motors		

ANNEX B

[Clause 15.1 (b)]

TYPES OF MOTORS**B-1 TYPES OF MOTORS****B-1.1 Capacitor Start Capacitor Run (Two-Value Capacitor Motor)**

These motors have higher starting torques and lower starting currents than split-phase motors and are suitable for frequent starting. They have a lower noise level, higher efficiency and power factor than split-phase motors and capacitor start and induction run motors (*see B-1.3*).

B-1.2 Capacitor Start and Run (Permanent Split Capacitor Motor)

These motors have lesser starting torque and starting current than capacitor start capacitor run motors and

are used where lower starting torques are acceptable. In the running condition, their characteristics are similar to capacitor start capacitor run motors.

B-1.3 Capacitor Start Induction Run (Capacitor Start Motor)

These motors have higher starting torques and lower starting currents than split-phase motors.

NOTE — This is the least preferred type since the load current is higher and efficiency and power factor are lower than the other two types. These motors have lesser starting torque and starting.

ANNEX C

(Foreword)

COMMITTEE COMPOSITION

Rotating Machinery Sectional Committee, ETD 15

<i>Organization</i>	<i>Representative(s)</i>
Bharat Heavy Electricals Ltd, Bhopal	SHRI ANISH VARSHNEY (<i>Chairman</i>)
ABB, Ltd, Faridabad	SHRI SWAPAN SARKAR SHRI SUMIT TYAGI (<i>Alternate</i>)
All India Electrical motor Association, Gujrat	SHRI SANJAY P. JADIA
Best Engineers Pumps Pvt Limited, Coimbatore	SHRI J. GOWRISANKAR
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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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